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Krishnapura et al.

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(54) **CEILING OR FLOOR SPACE MOUNTABLE HEAT CONTROL SYSTEM USING NETWORK COMPUTING DEVICES**

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(51) **Int. Cl.**

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G05B 15/02	(2006.01)
G05D 7/00	(2006.01)
H05K 7/14	(2006.01)
G05D 23/19	(2006.01)
H05K 7/20	(2006.01)

(52) **U.S. Cl.**

CPC ***H05K 7/1497*** (2013.01); ***G05D 23/1931*** (2013.01); ***H05K 7/20745*** (2013.01); ***H05K 7/20836*** (2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

(56) **References Cited**

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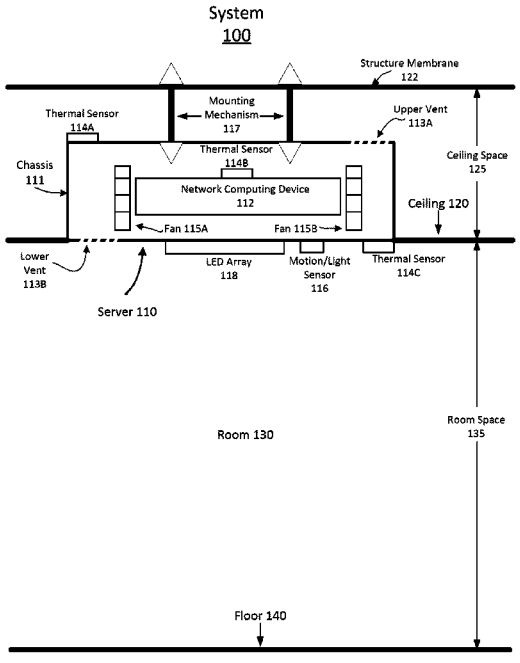
Assistant Examiner — Bernard G Lindsay

(57) **ABSTRACT**

Examples are disclosed for operating, managing or controlling one or more network computing devices housed in a chassis capable of being mounting in a ceiling space or a floor space for a room. Operating, managing or controlling may include adjusting one or more fans to direct airflow either away or towards the room or powering a light emitting diode array attached with the chassis to provide lighting to the room. Examples are also disclosed for using an aggregator to operate, manage or control an array of network computing devices separately housed in chassis capable of being mounted in a ceiling space or floor space for one or more rooms.

20 Claims, 9 Drawing Sheets



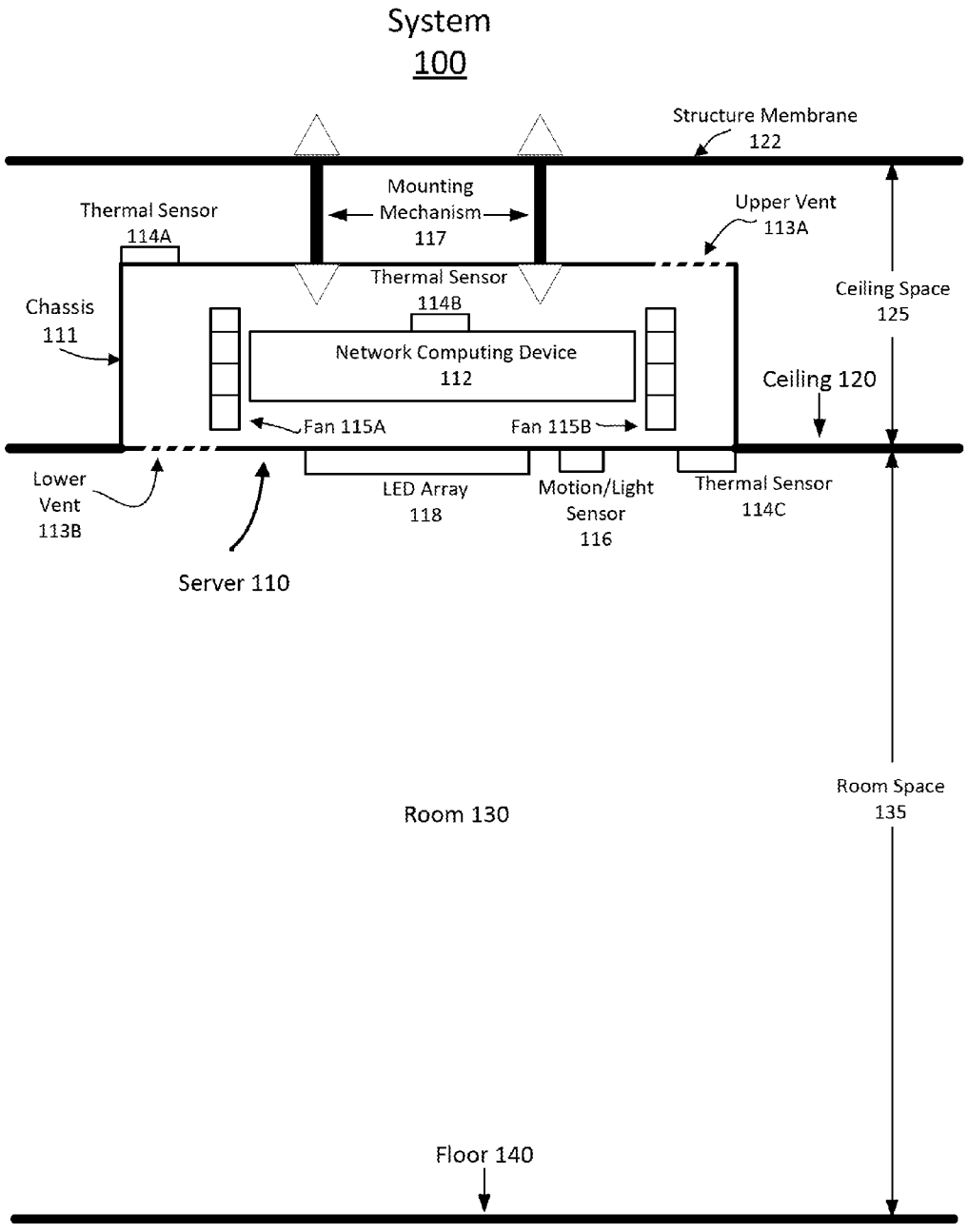

System
100
Structure Membrane
122
Mounting
Mechanism
117
Thermal Sensor
114A
Upper Vent
113A
Thermal Sensor
114B
Chassis
111
Ceiling Space
125
Network Computing Device
112
Ceiling 120
Fan 115A
Fan 115B
Lower
Vent
113B
LED Array
118
Motion/Light
Sensor
116
Thermal Sensor
114C
Server 110
Room Space
135
Room 130
Floor 140

FIG. 1

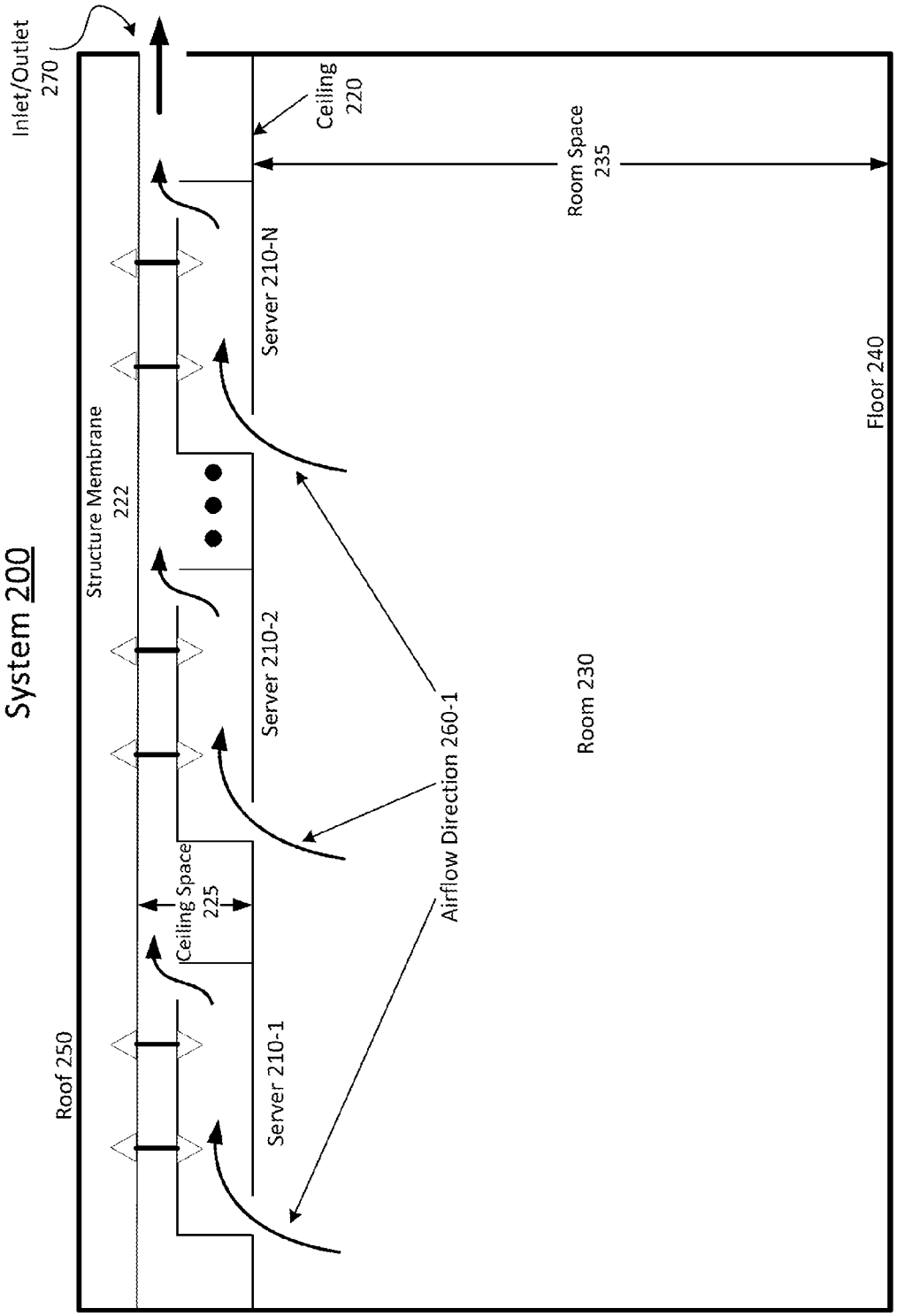

System 200
Inlet/Outlet 270
Ceiling 220
Room Space 235
Server 210-N
Structure Membrane 222
Floor 240
Server 210-2
Room 230
Airflow Direction 260-1
Ceiling Space 225
Server 210-1
Roof 250

FIG. 2A

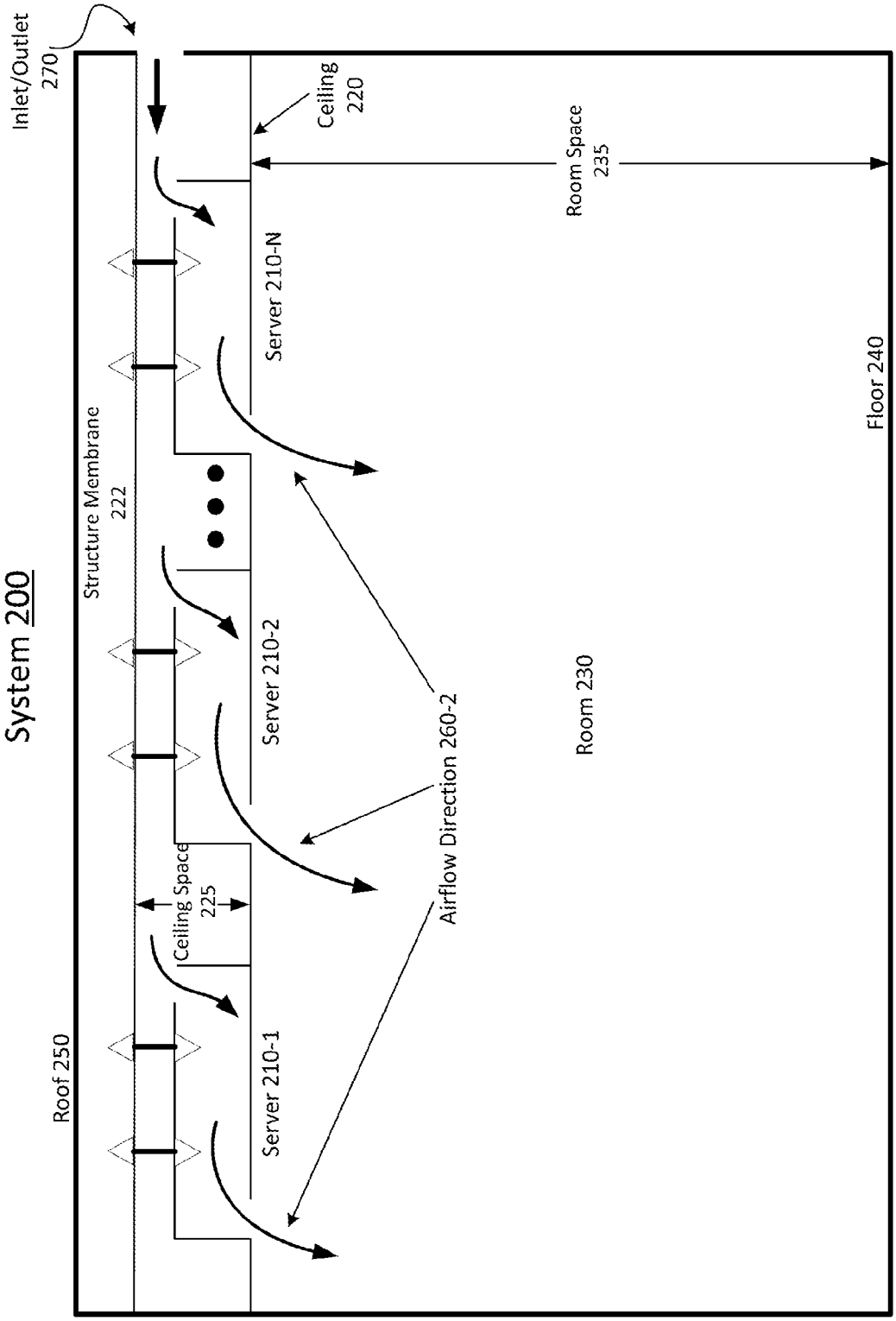

System 200
Inlet/Outlet 270
Ceiling 220
Room Space 235
Server 210-N
Structure Membrane 222
Floor 240
Server 210-2
Room 230
Airflow Direction 260-2
Ceiling Space 225
Server 210-1
Roof 250

FIG. 2B

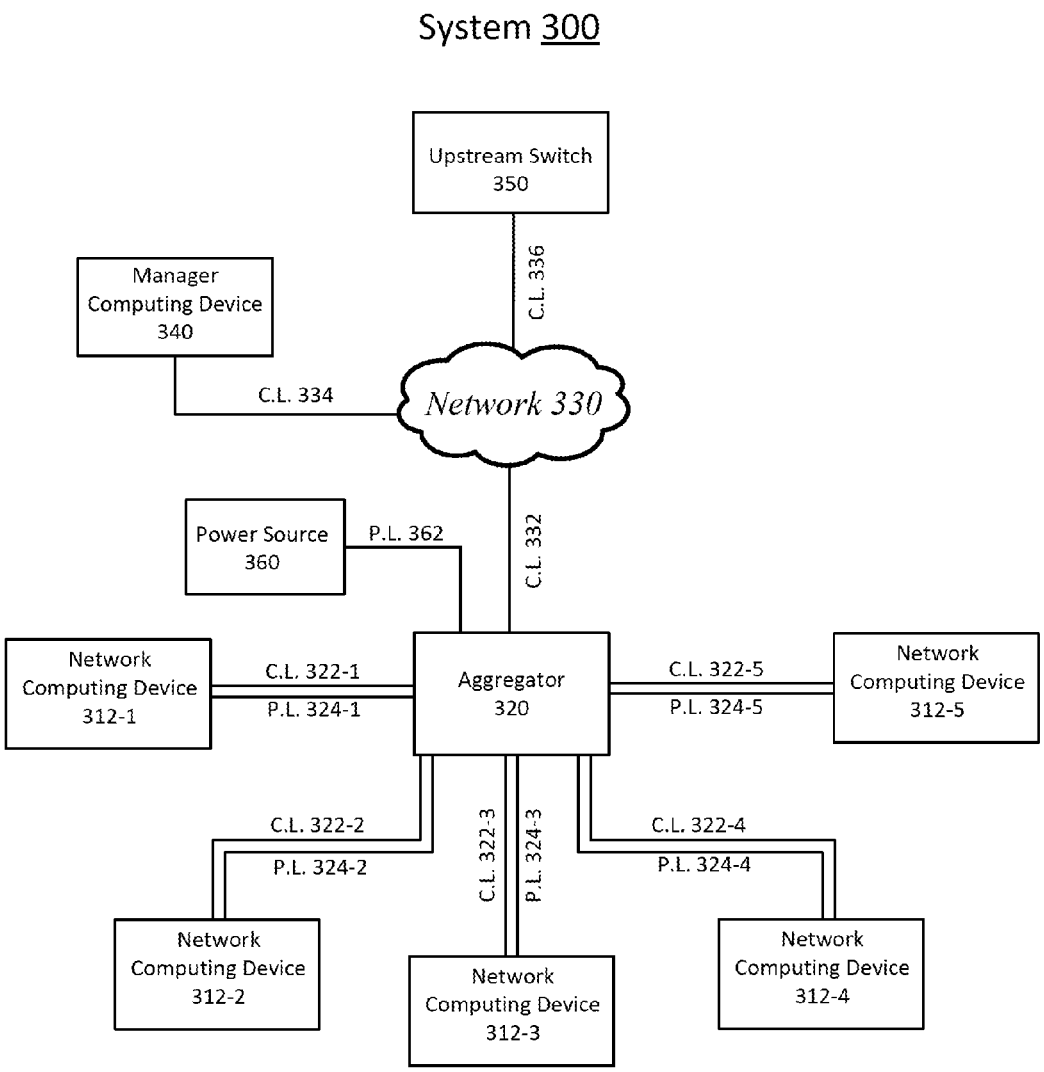

System 300
Upstream Switch 350
C.L. 336
Manager Computing Device 340
C.L. 334
Network 330
Power Source 360
P.L. 362
C.L. 332
Network Computing Device 312-1
C.L. 322-1
P.L. 324-1
Aggregator 320
C.L. 322-5
P.L. 324-5
Network Computing Device 312-5
C.L. 322-2
P.L. 324-2
C.L. 322-3
P.L. 324-3
C.L. 322-4
P.L. 324-4
Network Computing Device 312-2
Network Computing Device 312-3
Network Computing Device 312-4

FIG. 3

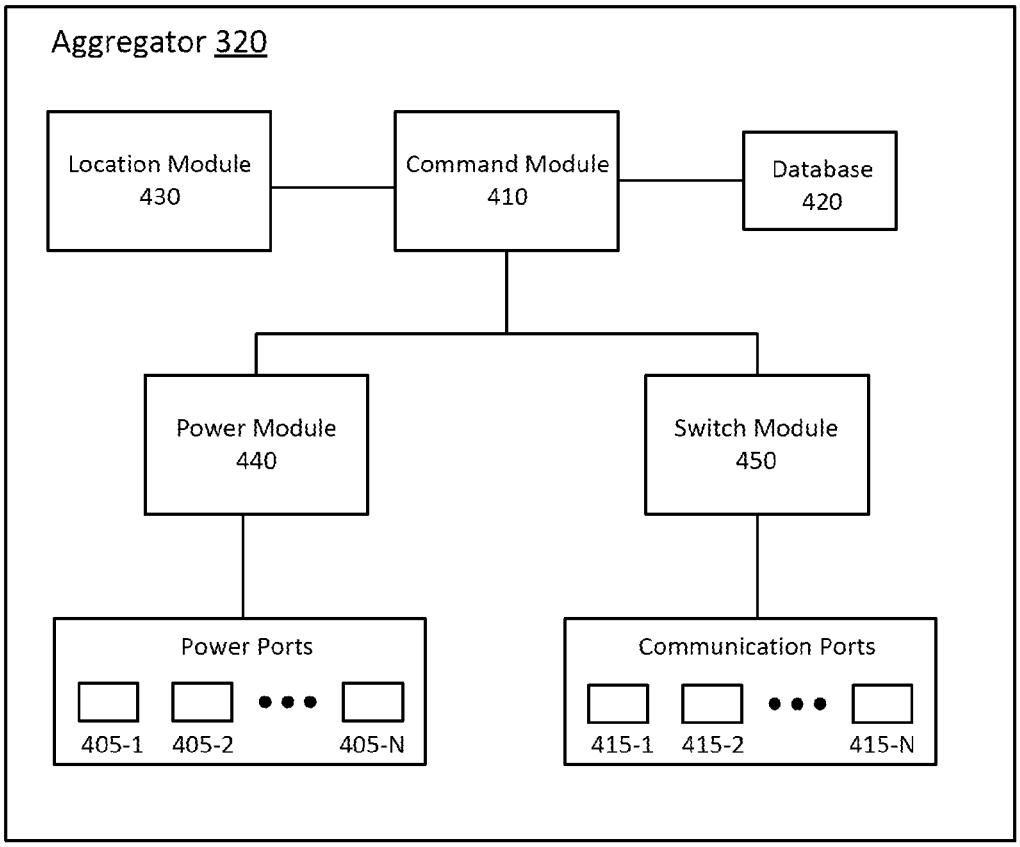

Aggregator 320
Location Module 430
Command Module 410
Database 420
Power Module 440
Switch Module 450
Power Ports
405-1
405-2
405-N
Communication Ports
415-1
415-2
415-N

FIG. 4

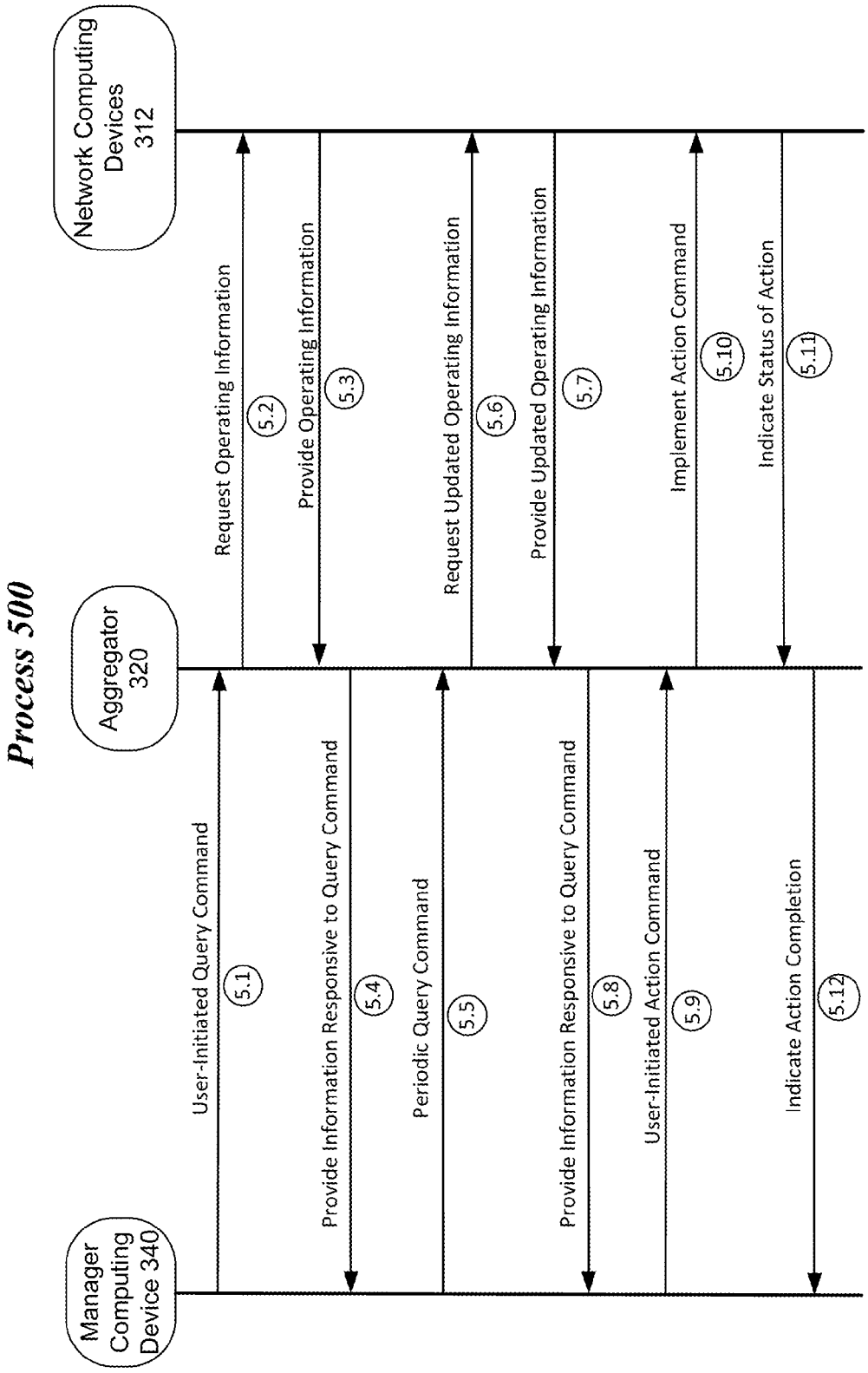

Process 500
Manager Computing Device 340
Aggregator 320
Network Computing Devices 312
User-Initiated Query Command
5.1
Request Operating Information
5.2
Provide Operating Information
5.3
Provide Information Responsive to Query Command
5.4
Periodic Query Command
5.5
Request Updated Operating Information
5.6
Provide Updated Operating Information
5.7
Provide Information Responsive to Query Command
5.8
User-Initiated Action Command
5.9
Implement Action Command
5.10
Indicate Status of Action
5.11
Indicate Action Completion
5.12

FIG. 5

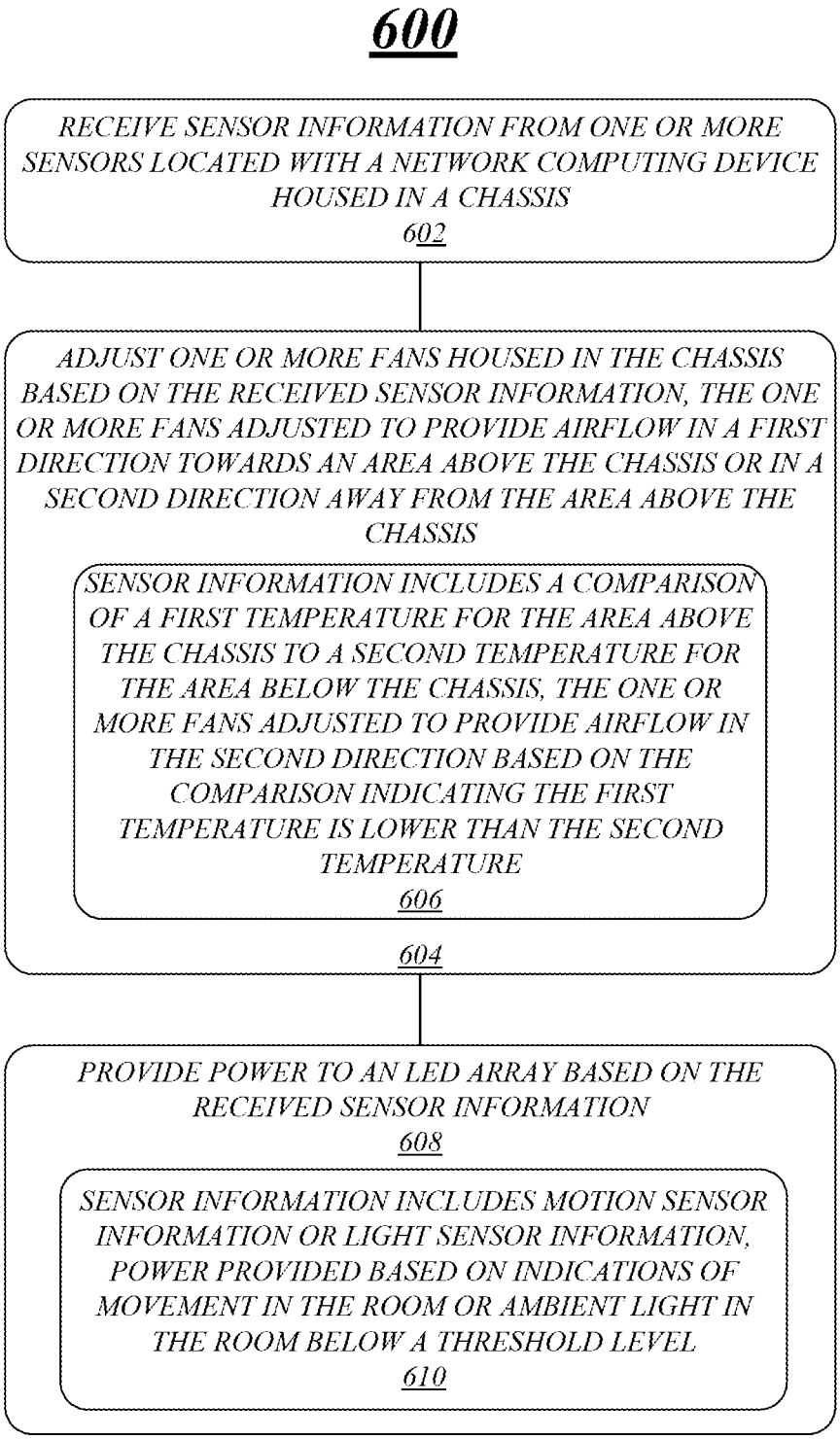

600
RECEIVE SENSOR INFORMATION FROM ONE OR MORE SENSORS LOCATED WITH A NETWORK COMPUTING DEVICE HOUSED IN A CHASSIS
602
ADJUST ONE OR MORE FANS HOUSED IN THE CHASSIS BASED ON THE RECEIVED SENSOR INFORMATION, THE ONE OR MORE FANS ADJUSTED TO PROVIDE AIRFLOW IN A FIRST DIRECTION TOWARDS AN AREA ABOVE THE CHASSIS OR IN A SECOND DIRECTION AWAY FROM THE AREA ABOVE THE CHASSIS
SENSOR INFORMATION INCLUDES A COMPARISON OF A FIRST TEMPERATURE FOR THE AREA ABOVE THE CHASSIS TO A SECOND TEMPERATURE FOR THE AREA BELOW THE CHASSIS, THE ONE OR MORE FANS ADJUSTED TO PROVIDE AIRFLOW IN THE SECOND DIRECTION BASED ON THE COMPARISON INDICATING THE FIRST TEMPERATURE IS LOWER THAN THE SECOND TEMPERATURE
606
604
PROVIDE POWER TO AN LED ARRAY BASED ON THE RECEIVED SENSOR INFORMATION
608
SENSOR INFORMATION INCLUDES MOTION SENSOR INFORMATION OR LIGHT SENSOR INFORMATION, POWER PROVIDED BASED ON INDICATIONS OF MOVEMENT IN THE ROOM OR AMBIENT LIGHT IN THE ROOM BELOW A THRESHOLD LEVEL
610

FIG. 6

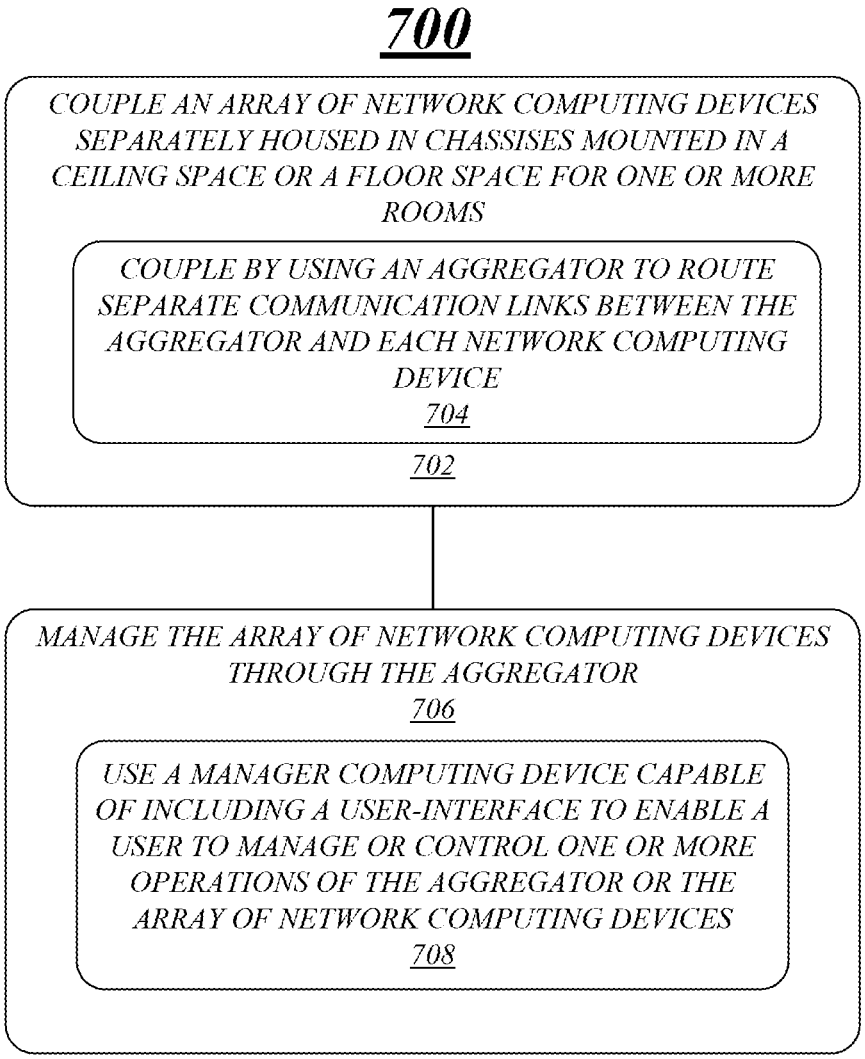

700
COUPLE AN ARRAY OF NETWORK COMPUTING DEVICES SEPARATELY HOUSED IN CHASSISES MOUNTED IN A CEILING SPACE OR A FLOOR SPACE FOR ONE OR MORE ROOMS
COUPLE BY USING AN AGGREGATOR TO ROUTE SEPARATE COMMUNICATION LINKS BETWEEN THE AGGREGATOR AND EACH NETWORK COMPUTING DEVICE
704
702
MANAGE THE ARRAY OF NETWORK COMPUTING DEVICES THROUGH THE AGGREGATOR
706
USE A MANAGER COMPUTING DEVICE CAPABLE OF INCLUDING A USER-INTERFACE TO ENABLE A USER TO MANAGE OR CONTROL ONE OR MORE OPERATIONS OF THE AGGREGATOR OR THE ARRAY OF NETWORK COMPUTING DEVICES
708

FIG. 7

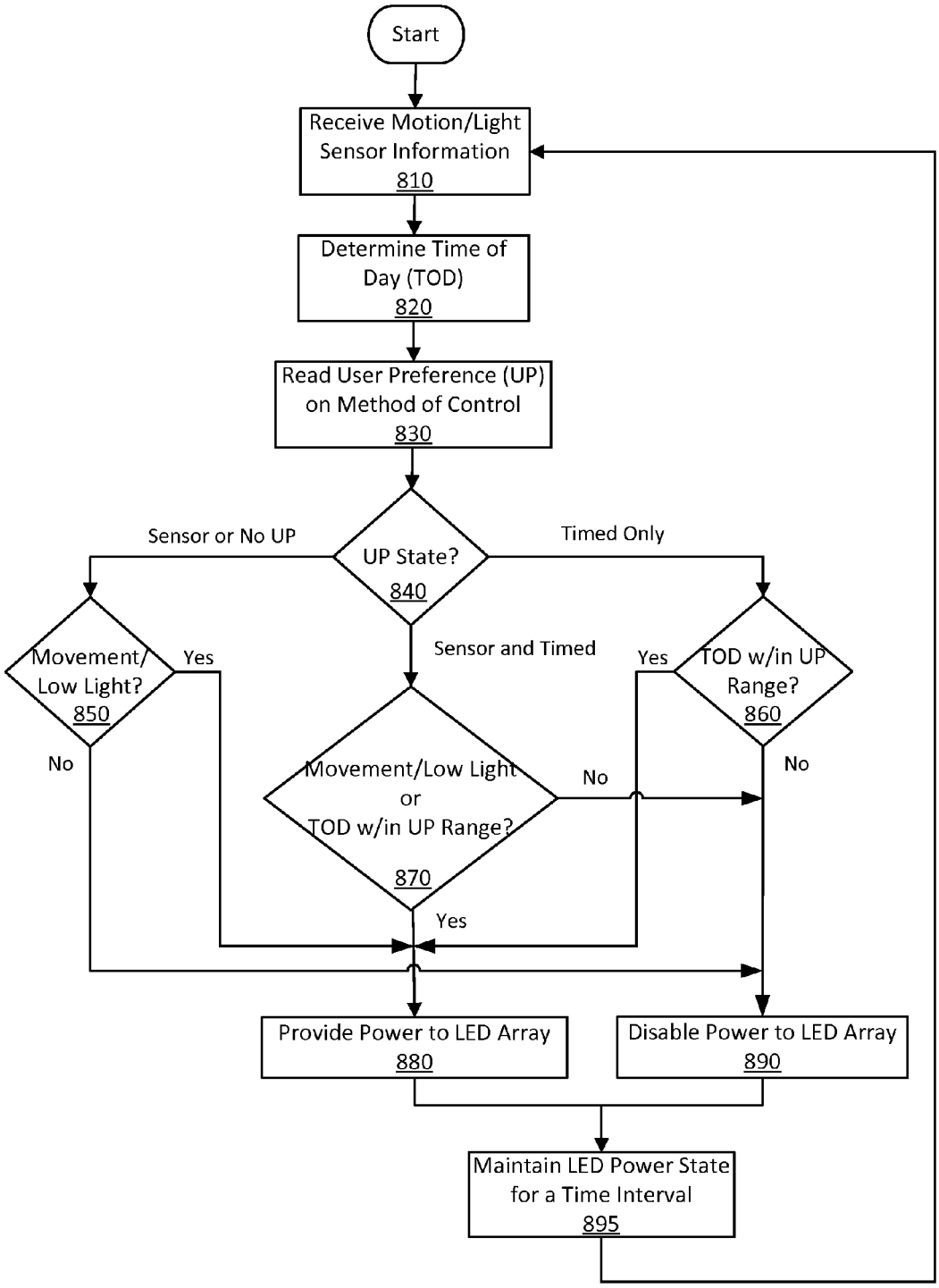

Start
Receive Motion/Light Sensor Information 810
Determine Time of Day (TOD) 820
Read User Preference (UP) on Method of Control 830
UP State? 840
Sensor or No UP
Timed Only
Sensor and Timed
Movement/ Low Light? 850
Yes
No
TOD w/in UP Range? 860
Yes
No
Movement/Low Light or TOD w/in UP Range? 870
No
Yes
Provide Power to LED Array 880
Disable Power to LED Array 890
Maintain LED Power State for a Time Interval 895

FIG. 8

CEILING OR FLOOR SPACE MOUNTABLE HEAT CONTROL SYSTEM USING NETWORK COMPUTING DEVICES

BACKGROUND

Network computing devices such as servers may come in two types of form factors. A rack-mountable form factor may be one type that includes one or more servers mounted in a single enclosure. Multiple enclosures including these rack-mountable servers may be co-located in a server farm or data center and usually require specialized cooling systems to remove generated heat. Another type of form factor may be tower or pedestal style server enclosures. Tower server enclosures may be free standing and most designs are not stackable. Tower server enclosures may typically include fans to remove generated heat. Rack-mountable servers may utilize space more efficiently but specialized cooling systems can be expensive. Tower server enclosures may not require expensive, specialized cooling systems but potentially valuable building space may be needed for these free standing enclosures.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates an example first system.

FIGS. **2**A-B illustrate an example second system.

FIG. **3** illustrates an example third system.

FIG. **4** illustrates a block diagram of an example aggregator.

FIG. **5** illustrates a block diagram of an example process for managing an array of network computing devices.

FIG. **6** illustrates an example logic flow for receiving sensor information.

FIG. **7** illustrates an example flow diagram for coupling an array of network computing devices.

FIG. **8** illustrates an example flow diagram for providing power to a light emitting diode (LED) array.

DETAILED DESCRIPTION

As contemplated in the present disclosure, rack-mountable servers may require expensive, specialized cooling systems and tower server enclosures may consume potentially valuable building space. Efforts are needed to more efficiently utilize building space when deploying servers and yet do so in a manner that does not require expensive cooling systems. One possible solution is to disperse servers or network computing devices in a decentralized manner that reduces or eliminates the need for specialized cooling. However, dispersal using tower enclosures in a decentralized deployment still uses valuable building space. Further, decentralized network computing devices may also lead to added asset tracking and manageability costs due to a lack of consistent, modular or integrated server management techniques. It is with respect to these and other challenges that the examples described herein are needed.

In some examples, techniques are implemented for a ceiling space or floor space mountable network computing device. For these examples, sensor information may be received from one or more sensors located with the network computing device. The network computing device may be housed in a chassis (e.g., mounted in a ceiling space or a floor space of a room). One or more fans housed in the chassis may be adjusted based on the received sensor information. The one or more fans may be adjusted to provide airflow in a first direction towards an area above the chassis or in a second direction away from the area above the chassis. The first direction may be towards an attic above the ceiling space if the chassis is mounted in a ceiling space or may be towards the room above the floor space if the chassis is mounted in a floor space. Also, the second direction may be towards the room below the ceiling space if the chassis is mounted in the ceiling space or away from the room (e.g., towards a crawl space) if the chassis is mounted in the floor space.

According to some examples, other techniques are implemented for the ceiling space or floor space mountable network computing device. For these examples, an array of network computing devices separately housed in chassises mounted in a ceiling space or a floor space for one or more rooms may be coupled using an aggregator to route separate communication links between the aggregator and each network computing device of the array. The array of network computing devices may then be managed through the aggregator using a manager computing device capable of including a user-interface to enable a user to manage or control one or more operations of the aggregator or the array of network computing devices.

FIG. **1** illustrates an example first system. In some examples, as shown in FIG. **1**, the example first system includes system **100**. As shown in FIG. **1**, system **100** includes a server **110**, a ceiling **120**, a room **130** and a floor **140**. Also as shown in FIG. **1**, a ceiling space **125** is shown between ceiling **120** and structure membrane **122** and a room space **135** is shown between ceiling **120** and floor **140**. Although not shown in FIG. **1**, in some examples, server **110** may also be mounted in a floor space below room **130**.

According to some examples, as shown in FIG. **1**, server **110** may include a chassis **111**, a network computing device **112**, an upper vent **113**A, a lower vent **113**B, thermal sensors **114**A-C, fans **115**A-B, a motion/light sensor **116**, a mounting mechanism **117** or a light emitting diode (LED) array **118**. As shown in FIG. **1**, at least some elements of server **110** may be arranged on a lower portion of chassis **111**. For example, lower vent **113**B, motion/light sensor **116**, thermal sensor **114**C and LED array **118** may be arranged such that these elements protrude at least partially into room space **135** when server **110** is mounted to structure membrane **122** via mounting mechanism **117**. Also, network computing device **112**, upper vent **113**A, thermal sensors **114**A-B and fans **115**A-B may be in a portion of chassis **111** that is mostly within ceiling space **125**.

In some examples, network computing device **112** may be deployed as part of an array of network computing devices. The array of network computing devices may provide individual or distributed computing resources as part of a server farm, data center, software as a service provider, cloud computing support infrastructure, grid computing, utility computing, etc. According to some examples, as described more below, the array of network computing devices may be mounted in a ceiling space such as ceiling space **125** and/or mounted in a floor space below floor **140**. The ceiling/floor space may be above/below one or more rooms. In some aspects, the array of network computing devices may function as a virtual rack of servers in order to provide individual or distributed computing resources over a network.

In some examples, chassis **111** may be capable of channeling (e.g., via one or more air ducts—not shown) airflow provided by fan **115**A and/or fan **115**B to remove heat generated by network computing device **112**. For these examples, server **110** may include logic and/or features capable of receiving sensor information from thermal sensors **114**A, **114**B or **114**C. Based on the received sensor

information, fan **115**A and/or fan **115**B may be adjusted to provide airflow in a first direction towards an area above chassis **111** or in a second direction towards an area below chassis **111**. For example, the first direction may include a provided airflow that comes into chassis **111** through lower vent **113**B and then out through upper vent **113**A. The second direction may include a provided airflow that comes into chassis **111** through upper vent **113**A and then out through lower vent **113**B.

According to some examples, sensor information received from thermal sensor **114**A may indicate a first temperature associated an area above chassis **111** (e.g., ceiling space **125**). Sensor information received from thermal sensor **114**C may indicate a second temperature associated with an area below chassis **111** (e.g., room space **135**). Sensor information received from thermal sensor **114**B may indicate a third temperature associated network computing device **112** or one or more components of networking computing device **112** (e.g., a processing unit or processor circuit). For these examples, the third temperature provided by thermal sensor **114**B may indicate when an airflow may be needed to expel heat from chassis **111**. Received sensor information may also include a comparison of the first temperature provided by thermal sensor **114**A to the second temperature provided by thermal sensor **114**C. For example, if the first temperature is lower than the second temperature this indicates that area above chassis **111** may be cooler than the area below chassis **111**. Based on a determination of the area above chassis **111** being cooler than the area below chassis **111**, fan **115**A and/or fan **115**B may be adjusted to provide airflow through chassis **111** in the first direction towards the area above chassis **111** as mentioned above. In another example, if the first temperature is higher than the second temperature this indicates that the area above chassis **111** may be warmer than the area below chassis **111**. Based on a determination of the area above chassis **111** being warmer than the area below chassis **111**, fan **115**A and/or fan **115**B may be adjusted to provide airflow through chassis **111** in the second direction away from the area above chassis **111** as mentioned above.

In some examples, server **110** may include logic, features or elements (not shown) to provide power to LED array **118** based on received sensor information. For these examples, LED array **118** may be capable of providing or augmenting lighting to room **130** once power is provided. The received sensor information may be received from motion/light sensor **116** and may include indications of movement in room **130** or indications that an ambient light level in room **130** has fallen below a threshold light level. The threshold light level may account for light levels adequate for a worker to perform work functions in room **130** or to provide security lighting to monitor room **130** (e.g., via a surveillance cameras).

According to some examples, server **110** may also include logic, features or elements to provide power to LED array **118** based on received sensor information or based on a given time of day associated with a 24-hour clock or cycle. For example, server **110** may be capable of providing power to LED array **118** based on typical work periods such as 7 a.m. to 5 p.m.

FIGS. **2**A-B illustrate an example second system. In some examples, as shown in FIGS. **2**A-B, the second system includes system **200**. As shown in FIGS. **2**A-B, system **200** includes servers **210-1** to **210**-N (where N is any positive whole integer>2). In some examples, as shown in FIG. **2**, servers **210-1** to **210**-N may be separately mounted to a structure membrane **222** in a ceiling space **225** for a ceiling **220** above a room **230** and a floor **240**. Also, an inlet/outlet **270** is shown between structure membrane **222** and a roof **250**. According to some examples, the area between ceiling **220** and roof **250** may be at least a portion of an attic space for a building structure including one or more rooms such as room **230** and inlet/outlet **270** may provide an inlet/outlet for the attic. Cooler air from outside of the building structure may come into ceiling space **225** via inlet/outlet **270**. Alternatively, warmer air may be pushed out of inlet/outlet **270** from ceiling space **225**.

Although not shown in FIGS. **2**A-B, in some examples, servers **210-1** to **210**-N may also be mounted in a floor space below floor **240**. For these examples, an inlet/outlet similar to inlet/outlet **270** may be located with the floor space below floor **240** to provide an inlet/outlet for the floor space. So similar to above, cooler air from outside of the building structure may come into the floor space via this inlet/outlet or warmer air may be pushed out of this inlet/outlet.

In some examples, as shown in FIG. **2**A, airflow direction **260-1** may indicate airflow movement away from room **230**. For these examples, servers **210-1** to **210**-N may include similar elements or components as mentioned above for server **110** in FIG. **1**. These components may include thermal sensors to provide sensor information that causes logic and/or features of servers **210-1** to **210**-N to adjust fans for these servers in order to cause airflow direction **260-1** as shown in FIG. **2**A. The sensor information may indicate that room space **235** is cooler that ceiling space **225**. The cooler air pulled from room **230** may then be channeled to flow through servers **210-1** to **210**-N. The air channeled to flow through servers **210-1** to **210**-N may become heated (e.g., by an operating network computing device) and this heated air may then flow out of ceiling space **225** via inlet/outlet **270**.

According to some examples, as shown in FIG. **2**B, airflow direction **260-2** may indicate airflow movement toward room **230**. For these examples, thermal sensors located with servers **210-1** to **210**-N may provide sensor information that causes logic and/or features of servers **210-1** to **210**-N to adjust fans for these servers in order to cause airflow direction **260-2** as shown in FIG. **2**B. The sensor information may indicate that ceiling space **225** is cooler than room space **235**. In some examples, the cooler air of ceiling space **225** may then be channeled to flow into through servers **210-1** to **210**-N. The air channeled to flow through servers **210-1** to **210**-N may become heated (e.g., by an operating network computing device) and this heated air may then flow into room **230**. The pulling of the cooler air of ceiling space **225** towards room space **235** may also cause possibly cooler outside air to be pulled into ceiling space **225** via inlet/outlet **270**.

In some examples, heated air directed into room **230** as described above for FIG. **2**B may be used to at least augment heating for room **230**. For these examples, room **230** may be an office space occupied by workers. The building may be geographically located in an area having relatively cooler outside temperatures. Cool air brought into ceiling space **225** via inlet/outlet **270** may be heated as mentioned above. The heated air may then be used to at least augment workspace heating to provide a comfortable work environment.

FIG. **3** illustrates an example third system. In some examples, as shown in FIG. **3**, the third system includes system **300**. As shown in FIG. **3**, system **300** includes network computing devices **312-1** to **312-5**, an aggregator **320**, a network **330**, a manager computing device **340** and an upstream switch **350**.

According to some examples, as shown in FIG. **3**, aggregator **320** may couple to a power source **360** via power link

(P.L.) **362** and couple to network computing devices **312-1** to **312-5** via separate communication links (C.L.s) **322-1** to **322-5**, respectively. Aggregator **320** may also couple to network computing devices **312-1** to **312-5** via separate P.L.s **324-1** to **324-5**, respectively. Also, as shown in FIG. **3**, aggregator **320**, manager computing device **340** and upstream switch **350** may couple to network **330** via C.L.s **332**, **334** and **336**, respectively.

In some examples, network **330** may be configured or arranged to operate as a type of closed network or intranet that allows aggregator **320**, manager computing device **340** and upstream switch **350** to exchange network data traffic to include data and/or instructions. For these examples, network **330** and C.L.s **332**, **334** or **335** may be operated according to one or more communication standards or protocols such as those associated with progenies and/or variants of Institute of Electrical and Electronics Engineers (IEEE) 802.3-2008, Carrier sense Multiple access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications, Published in December 2008 (hereinafter "the Ethernet standard"). Also, for these examples, manager computing device **340** and/or upstream switch **350** may be located remote to a physical location of aggregator **320** (e.g., in a different building or geographic location). Alternatively, manager computing device **340** and/or upstream switch **350** may be located in a same building or geographic location in relation to a physical location of aggregator **320**.

According to some examples, upstream switch **350** may serve as an attachment point for data processed or to be processed by network computing devices **312-1** to **312-5**. For these examples, upstream switch **350** may be capable of operating according to the Ethernet standard and may couple to a larger network such as the Internet, a wide area network (WAN), a metropolitan area network (MAN) or a campus area network (CAN). This disclosure is not limited to these types of larger networks. Data processed by one or more of network computing devices **312-1** to **312-5** may be aggregated by aggregator **320** and then forwarded through C.L. **332** to network **330** and then through C.L. **336** to reach upstream switch **350**. For other examples, data destined for and/or to be processed by one or more of network computing devices **312-1** to **312-5** may be forwarded from upstream switch **350** via C.L. **336** to network **330** and then through C.L. **332** to reach aggregator **320**. For these other examples, aggregator **320** may then forward data destined for a given network computing device to that given network computing device.

In some examples, as mentioned above, separate P.L.s **324-1** to **324-5** may be coupled between network computing devices **312-1** to **312-5** and aggregator **320**. For these examples, P.L.s **324-1** to **324-5** may be capable of providing full operational power to network computing devices **312-1** to **312-5** through aggregator **320**.

In some examples, although not shown in FIG. **3**, network computing devices **312-1** to **312-5** may be separately housed in chassises mounted in a ceiling space or a floor space for one or more rooms. These chassises may be capable of being mounted as described above for server **110** for FIG. **1**. The chassises separately housing network computing devices **312-1** to **312-5** may include similar elements as server **110** to include, but not limited to fans, sensors, LED arrays and vents. According to some examples, power provided via P.L.s **324-1** to **324-5** may also power these similar elements.

According to some examples, communications routed through or to aggregator **320** may enable manager computing device **340** to manage network computing devices **312-1** to **312-5** through aggregator **320**. For these examples, manager computing device **340** may include a user-interface (e.g., a keyboard/display or touch screen—not shown) to enable a user to manage or control one or more operations of aggregator **320** or the array of network computing device **312-1** to **312-5**. As described more below, a user may initiate query or action commands to manage or control the one or more operations. The query or action commands, for example, may be forwarded via C.L. **334** to network **330** and then forwarded to aggregator **320** via C.L. **332**.

According to some alternative examples, other power links may provide at least some or all operational power to network computing devices **312-1** to **312-5**. For these alternative examples, aggregator **320** may provide none or at least a portion of the operational power via P.L.s **324-1** to **324-5**.

In some examples, C.L.s **322-1** to **322-5** may be routed from aggregator **320** to their respective network computing devices **312-1** to **312-5** via cables separate from P.L.s **324-1** to **324-5**. For these examples, the separate cables may be various types that may include, but is not limited to Fast Ethernet type cables (e.g., 100Base-T, 100Base-TX, 100Base-T4, 100Base-T2, 100Base-FX, 100Base-SX, 100BaseBX, and so forth), Gigabit Ethernet (GbE) type cables (e.g., 1000Base-T, 1000Base-SX, 1000Base-LX, 1000Base-BX10, 1000Base-CX, 1000Base-ZX, and so forth), 10 GbE type cables (e.g., 10GBase-SR, 10GBase-LRM, 10GBase-LR, 10GBase-ER, 10GBase-ZR, 10GBase-LX4, 10GBase-CX4, 10GBase-Kx, 10GBase-T, and so forth) or 100 GbE type cables. Aggregator **320** and network computing devices **312-1** to **312-5** may also include relevant communication interfaces to support the above-mentioned types of cables.

In some examples, both C.L.s **322-1** to **322-5** and P.L.s **324-1** to **324-5** may be routed from aggregator **320** to their respective network computing devices **312-1** to **312-5** via a single cable. For example, the single cable may operate according one or more technologies such as Power over Ethernet or Ethernet over Power lines. A power source within aggregator **320** and/or accessible to aggregator **320** may be capable of providing enough power via a power link portion within the single cable. A switch source within aggregator **320** may also be capable of routing data via a communication link portion of the single cable. The single cable using PoE may be configured or arranged to operate according to IEEE 802.3 at-2009, Power over Ethernet Plus Standard, published in September 2009 ("PoE+" or "PoE plus") and/or progenies or variants of this PoE+ standard. The single cable using Ethernet or Power lines may be configured or arranged to operate according IEEE 1901-2010, IEEE Standard for Broadband over Power Line Networks: Medium Access Control and Physical Layer Specifications, published in December, 2010 ("IEEE 1901") This disclosure is not limited to only the PoE+ standard or the IEEE 1901-2010 specification for a routing and/or configuring power and communication links through a single cable.

FIG. **4** illustrates a block diagram of an example aggregator **320**. In some examples, aggregator **320** includes features and/or logic configured or arranged to couple to an array of network computing devices and/or communicate with a managing computing device. As shown in FIG. **4**, aggregator **320** includes power ports **405-1** to **405**-N, communication ports **415-1** to **415**-N, a command module **410**, a database **420**, a location module **430**, a power module **440** or a switch module **450**.

According to some examples, the elements portrayed in FIG. **4** are configured to support or enable aggregator **320** as described in this disclosure. A given aggregator **320** may include some, all or more elements than those depicted in FIG. **4**. For example, command module **410**, location module **430**, power module **440** or switch module **450** may separately or collectively represent a wide variety of logic device(s) or executable content to implement the features or elements of aggregator **320**. Example logic devices may include one or more of a microprocessor, a microcontroller, a processor circuit, a field programmable gate array (FPGA), an application specific integrated circuit (ASIC), a sequestered thread or a core of a multi-core/multi-threaded microprocessor, or a combination thereof.

In some examples, command module **410** communicates with a manager computing device (e.g., manager computing device **340**) to respond to commands received from the manager computing device. Command module **410** may include logic or features to implement received commands and/or forward at least some of the received commands to one or more network computing devices coupled to aggregator **320**. Command module **410** may also include logic or features to gather operating information received from the one or more network computing devices and at least temporarily store the gathered operating information in database **410**. Responsive to a received command (e.g., a query command) from the manager computing device, command module **410** may be capable of accessing database **420** and providing gathered operating information to the manager computing device.

According to some examples, database **420** may be arranged to at least temporarily store operation information gathered by command module **410**. Database **420** may include various types of non-volatile memory and may include at least one or a combination of different types of storage devices. These different types of storage devices may include, but are not limited to, one or more of a magnetic disk drive, an optical disk drive, a tape drive, an internal storage device, an attached storage device, flash memory, battery backed-up SDRAM (synchronous DRAM), a network accessible storage device, and/or other types of non-volatile memory (e.g., phase change memory (PCM)).

In some examples, location module **430** may include logic or features capable of gathering location information to indicate the physical location of aggregator **320**. Location module **430** may include location capabilities such as a global positioning system (GPS) receiver to determine a physical location of aggregator **320**. Physical location information determined by location module **430** may be provided to command module **410** for possible storage in database **420**. The physical location information may be later provided (e.g., by command module **410**) to a manager computing device in response to a received query command.

According to some examples, power module **440** may include logic or features arranged to provide power to one or more network computing devices coupled to aggregator **320**. For these examples, power module **440** may be capable of providing power through power ports **405-1** to **405**-N when a power link coupled to a network computing device is connected to a power port from among power ports **405-1** to **405**-N. The power provided may be sufficient to provide operational power to the network computing device. In some examples, power module **440** may be capable of changing a power state for the network computing device by cutting off power routed through the power port via which the power link to the network computing device is connected.

In some examples, switch module **450** may include logic or features arranged to route data and/or instructions to/from one or more network computing devices through communication ports **415-1** to **415**-N when a communication link coupled to a network computing device is connected to a communication port from among communication ports **415-1** to **415**-N. In some examples. Switch module **450** may be capable of supporting or implementing one or more communication industry standards or specifications to route data and/or instructions to include, but not limited to those associated with the Ethernet standard, the PoE+ standard or the IEEE 1901 specification.

According to some examples, power ports **405-1** to **405**-N and communication ports **415-1** to **415**-N may be combined to support a PoE+ or an IEEE 1901 configuration. For examples, a single PoE+ or IEEE 1901 cable may include both power links and communication links between aggregator **320** and a network computing device. So, for example, power port **405-1** and communication port **415-1** may be integrated such that the single PoE+ or IEEE 1901 cable may connect to these two ports and allow for both power and data to be routed to the network computing device.

FIG. **5** illustrates a block diagram of an example process for managing an array of network computing devices. In some examples, process **500** may be for managing an array of network computing devices **312** through aggregator **320** using manager computing device **340**. For these examples, elements of systems **100**, **200** or **300** as shown in FIGS. **1-3** or elements of aggregator **320** as shown in FIG. **4** may be used to illustrate example operations related to process **500**. The described example operations are not limited to these elements as shown in FIGS. **1-4**. Also, for these examples, network computing devices **320** may be arranged as servers that are separately housed in chassises mounted in a ceiling space or a floor space for one or more rooms.

Beginning at process 5.1 (User-Initiated Query Command), a user-interface included at manager computing device **340** may be capable of enabling a user to initiate a query command. In some examples, the query command may include a request for operating information for aggregator **320** and/or network computing devices **312**. For these examples, the requested operating information for aggregator **320** and/or network computing device **312** may include an identification for aggregator **320** associated with a name or identifier via which the user or manager computing device **340** may uniquely identify aggregator **320**. The operating information may also include a physical location of aggregator **320**, separate media access control addresses for each network computing device from among network computing devices **312**, power states/statuses for each network computing device or thermal characteristics for each network computing device. This disclosure is not limited to only the operating information listed above, but may include any type of operating information of possible use to manager computing device **340** or the user for managing or controlling aggregator **320** or network computing devices **312**.

Proceeding to process 5.2 (Request Operating Information), logic and/or features at aggregator **320** (e.g., command module **410**) may be capable of receiving the user-initiated query command. In some examples, these logic and/or features may forward at least a portion of the query command to network computing devices **312**. The request for operating information may include at least some of the operating information mentioned above.

Proceeding to process 5.3 (Provide Operating Information), network computing devices **312** may include logic and/or features to respond to the request for operating

information. In some examples, one or more network computing devices from among network computing devices **312** may provide operating information. For these examples, the operating information provided by the one or more network computing devices may include media access control addresses, power states/statuses or thermal characteristics. A network computing device providing power states/statuses may indicate whether the network computing device is in an idle, standby or in various operating power states. A network computing device providing thermal characteristics may provide sensor information obtained by one or more thermal sensors located at or with the network computing device.

Proceeding to process 5.4 (Provide Information Responsive to Query Command), logic and/or features at aggregator **320** (e.g., command module **410**) may gather the operating information provided by network computing devices **312** and combine that operating information with operation information for aggregator **320** in order to provide information responsive to the query command. As shown in FIG. **5**, that information may be provided to manager computing device **340**.

Proceeding to process 5.5 (Periodic Query Command), manager computing device **340** may be capable of periodically sending query commands to aggregator **320**. According to some examples, the periodic query command may be sent at regular intervals (e.g., every 1 minute) to aggregator **320**. At least some of the operating information such as power states and thermal characteristics may be requested as part of the query command.

Proceeding to process 5.6 (Request Updated Operating Information), logic and/or features at aggregator **320** may receive the periodic query command and then forward at least a portion of the periodic query command to network computing devices **312** in a request for updated operating information. In some examples, the request for updated operating information may include a request for updated power states and/or updated thermal characteristics.

Proceeding to process 5.7 (Provide Updated Operating Information), network computing devices **312** may include logic and/or features to respond to the request for updated operating information. In some examples, one or more network computing devices from among network computing devices **312** may provide updated operating information to reflect current power states/statuses and/or thermal characteristics.

Proceeding to process 5.8 (Provide Information Responsive to Query Command), logic and/or features at aggregator **320** may gather the updated operating information provided by network computing devices **312** and combine that updated operating information with updated operation information for aggregator **320** in order to provide information responsive to the periodic query command. As shown in FIG. **5**, that updated information may be provided to manager computing device **340**.

Proceeding to process 5.9 (User-Initiated Action Command), a user-interface included at manager computing device **340** may be capable of enabling the user to initiate an action command. In some examples, the action command may modify one or more operating parameters for aggregator **320** and/or at least one network computing device from among network computing devices **312**. For some examples, the one or more operating parameters may include a direction of airflow provided by one or more fans included in the chassises for at least some network computing devices **312**. The action command to modify the direction of airflow may include directing the airflow either towards a room (see FIG. **2**A) or away from the room (see FIG. **2**B). For some examples, the one or more operating parameters may include powering on or off an LED array attached with a portion (e.g., a portion facing the floor of a room) of the chassises for at least some of network computing devices **312**.

According to some examples, the one or operating parameters may be a power state. For some examples, the power state of one or more network computing devices **312** may be modified by aggregator **320** by merely cutting off or providing power to power links coupled between aggregator **320** and network computing devices **312** based on instructions included in the action command. For other examples, aggregator **320** may forward the action command to enable logic and/or features at one or more network computing devices of network computing devices **312** to modify their respective power states (e.g., power down, standby, idle, power reset, etc.).

Proceeding to process 5.10 (Implement Action Command), network computing devices **312** may implement the received action command. In some examples, as mentioned above, implementing the action command may include, but is not limited to, modifying the direction of air flow, powering LED arrays or implementing power states.

Proceeding to process 5.11 (Indicate Status of Action), logic and/or features at aggregator **320** may be capable of receiving a status of implementation of the action command. In some examples, the received status may indicate whether the operating parameters were either successfully or unsuccessfully modified or implemented. An indication that the operating parameters were not successful may cause aggregator **320** to initiate a hard reset of at least some network computing devices **312** by cutting power and then providing power again. The hard reset may occur due to an operating system for a network computing device becoming unresponsive or inoperable.

Proceeding to process 5.12 (Indicate Action Completion), logic and/or features at aggregator **320** may be arranged to send an indication of completion of the previously received action command to manager computing device **340**. In some examples, the indication may be sent following receipt of the status of any action commands forwarded to network computing devices **312**. The process may then return to either process 5.1, 5.5 or 5.9. As mentioned above, processes 5.5 and 5.9 may depend on user-initiated actions and process 5.5 may occur periodically.

FIG. **6** illustrates a logic flow **600** for receiving sensor information in accordance with one or more examples. Logic flow **600** may be performed by various systems and/or devices and may be implemented as hardware, software, and/or any combination thereof, as desired for a given set of design parameters or performance constraints. For example, the logic flow **600** may be implemented by a logic device (e.g., processor) and/or logic (e.g., instructions, data, and/or code) to be executed by a logic device. For purposes of illustration, and not limitation, the logic flow **600** is described with reference to FIGS. **1** and **2**A-B.

According to some examples, logic flow **600** may receive sensor information from one or more sensors located with a network computing device housed in a chassis (e.g., mounted in a ceiling space or a floor space for a room) at block **602**. For example, server **110** may include logic and/or features (e.g., located with or at network computing device **112**) to receive the sensor information. The sensor information may have been obtained from various thermal or motion/light sensors located within or attached to outer portions of chassis **111** for server **110**.

In some examples, logic flow **600** may adjust one or more fans housed in the chassis based on the received sensor

information at blocks **604** and **606**. For example, server **110** may include logic and/or features to adjust fans **115**A and/or **115**B to provide airflow in a first direction towards an area above chassis **111** or in a second direction away from the area above chassis **111**. For these examples, the sensor information may include a comparison of a first temperature for the area above chassis **111** to a second temperature for the area below chassis **111**. The one or more fans may be adjusted to provide airflow in the second direction based on the comparison indicating the first temperature is lower than the second temperature.

According to some examples, logic flow **600** may provide power to an LED array based on the received sensor information at blocks **608** and **610**. For example, server **110** may include logic and/or features to provide power to LED array **118**. For these examples, the sensor information may include motion sensor information or light sensor information. The power may be provided based on indications of movement in the room **130** and/or ambient light in room **130** being below a threshold level.

FIG. **7** illustrates a logic flow **700** for coupling an array of network computing devices in accordance with one or more examples. Logic flow **700** may be performed by various systems and/or devices and may be implemented as hardware, software, and/or any combination thereof, as desired for a given set of design parameters or performance constraints. For example, the logic flow **700** may be implemented by a logic device (e.g., processor) and/or logic (e.g., instructions, data, and/or code) to be executed by a logic device. For purposes of illustration, and not limitation, the logic flow **700** is described with reference to FIGS. **1-5**.

According to some examples, logic flow **700** may couple an array of network computing devices separately housed in chassises mounted in a ceiling space or a floor space for one or more rooms at blocks **702** and **704**. For example, aggregator **320** may couple to network computing devices **312-1** to **312-5** via C.L.s **322-1** to **322-5**, respectively, as shown in FIG. **3**.

In some examples, logic flow **700** may manage the array of network computing devices through the aggregator at blocks **704** and **708**. For some examples, manager computing device **340** may be capable of including a user-interface to enable a user to manage or control one or more operations of aggregator **320** or network computing devices **312-1** to **312-5**. For these examples, managing or controlling the one or more operations may include, but is not limited to, the various processes described for process **500** as shown in FIG. **5**.

FIG. **8** illustrates an example flow diagram for providing power to an LED array. In some examples, elements of systems **100**, **200** or **300** as shown in FIGS. **1-3** may be used to illustrate example operations related to the flow chart depicted in FIG. **8**. The described example operations are not limited to implementations on systems **100**, **200** or **300** or to the elements describe therein for FIGS. **1-3**.

Moving from the start to block **810** (Receive Motion/Light Sensor Information), server **110** may include logic and/or features configured to receive motion/light sensor information. In some examples, the motion/light sensor information may be received from motion/light sensor **116**. For these examples, motion/light sensor **116** may be positioned or arranged on chassis **111** in such a manner as to sense motion and/or ambient light levels in room **130**.

Proceeding from block **810** to block **820** (Determine Time of Day (TOD)), server **110** may include logic and/or features configured to determine a time of day. In some examples, the time of day may be determined by a clock maintained by or accessible to server **110**. For these examples, the clock used to determine the time of day may be based on a geographic location of server **110**, e.g., Pacific Time if located on the west coast of the United States.

Proceeding from block **820** to block **830** (Read User Preference (UP) on Method of Control), server **110** may include logic and/or features configured to receive an UP preference on a method of control. In some examples, the UP on method of control may have been received from an aggregator such as aggregator **320**. For these examples, manager computing device such as manager computing device **340** may have forwarded the UP on method of control to aggregator **320** following a user indicating their preference for how LED array **118** may be powered. Aggregator **320** may have then forwarded the UP on method of control to server **110**. Server **110** may then at least temporarily store the UP on method of control (e.g., in a memory maintained at or with network computing device **112**).

Proceeding from block **830** to decision block **840** (UP State?), based on the UP state the process may move to decision blocks **850**, **860** or **870**. If there was no UP on method of control, the default is move the process to decision block **850**. If the UP on method of control indicates timed only, the process moves to decision block **860**. If the UP on method of control indicates sensor and timed, the process moves to decision block **870**.

Moving from decision block **840** to decision block **850** (Movement/Low Light?), server **110** may include logic and/or features capable of determining whether the received motion/light sensor information indicates movement/low light. In some examples, sensed movement or light levels may be compared to threshold levels for movement or light levels. If the sensed movement or light levels exceed the threshold levels, the process moves to block **880**. Otherwise, the process moves to block **890**.

Moving from decision block **840** to decision block **860** (TOD w/in UP Range?), server **110** may include logic and/or features capable of determining whether a given time of day is within a range of times indicated in the UP on method of control. In some examples range may be associated with typical business operating hours such as 7 a.m. to 5 p.m. In other examples, the range may be associated with times of the day that people ordinarily occupy room **130**. In yet other examples, the range may be based on typical daylight hours that may vary based on the time of year. If the time of day is within the range the process moves to block **880**. Otherwise, the process moves to block **890**.

Moving from decision block **840** to decision block **870** (Movement/Low Light or TOD w/in UP Range?), server **110** may include logic and/or features capable of determining whether the received motion/light sensor information indicates movement/low light or whether a given time of day is within a range of times indicated in the UP on method of control. In some examples, if the received sensor information indicates movement/low light or whether a given time of day is within a range of times the process moves to block **880**. Otherwise, the process moves to block **890**.

Moving from decision blocks **850**, **860** or **870** to block **880** (Provide Power to LED Array), server **110** may provide power to LED array.

Moving from decision blocks **850**, **860** or **870** to block **890** (Disable Power to LED Array), server **110** may either not power the LED array or disable power to the LED array if power was currently being provided.

Proceeding from either block **880** or block **890** to block **895** (Maintain LED Power State for a Time Interval), server **110** may include logic and/or features to maintain the LED

power state established in blocks **880** or **890** for a time interval. In some examples, the time interval may depend on the manner of which the LED array was provided power. For example, if movement causes the LED array to be powered, the time interval may be several minutes. However, if time of day causes the LED array to be powered, the time interval may be as long as the amount of time of the range indicated in the UP state. Also, if the received sensor information or TOD causes the LED array to not be powered, the time interval may be relatively short, e.g., around one second. After the time interval has expired the process may move to block **810**.

One or more aspects of at least one example may be implemented by representative instructions stored on at least one machine-readable medium which represents various logic within the processor, which when read by a machine, computing device or system causes the machine, computing device or system to fabricate logic to perform the techniques described herein. Such representations, known as "IP cores" may be stored on a tangible, machine readable medium and supplied to various customers or manufacturing facilities to load into the fabrication machines that actually make the logic or processor.

Various examples may be implemented using hardware elements, software elements, or a combination of both. In some examples, hardware elements may include devices, components, processors, microprocessors, circuits, circuit elements (e.g., transistors, resistors, capacitors, inductors, and so forth), integrated circuits, application specific integrated circuits (ASIC), programmable logic devices (PLD), digital signal processors (DSP), field programmable gate array (FPGA), memory units, logic gates, registers, semiconductor device, chips, microchips, chip sets, and so forth. In some examples, software elements may include software components, programs, applications, computer programs, application programs, system programs, machine programs, operating system software, middleware, firmware, software modules, routines, subroutines, functions, methods, procedures, software interfaces, application program interfaces (API), instruction sets, computing code, computer code, code segments, computer code segments, words, values, symbols, or any combination thereof. Determining whether an example is implemented using hardware elements and/or software elements may vary in accordance with any number of factors, such as desired computational rate, power levels, heat tolerances, processing cycle budget, input data rates, output data rates, memory resources, data bus speeds and other design or performance constraints, as desired for a given implementation.

Some examples may include an article of manufacture or at least one computer-readable medium. A computer-readable medium may include a non-transitory storage medium to store logic. In some examples, the non-transitory storage medium may include one or more types of computer-readable storage media capable of storing electronic data, including volatile memory or non-volatile memory, removable or non-removable memory, erasable or non-erasable memory, writeable or re-writeable memory, and so forth. In some examples, the logic may include various software elements, such as software components, programs, applications, computer programs, application programs, system programs, machine programs, operating system software, middleware, firmware, software modules, routines, subroutines, functions, methods, procedures, software interfaces, API, instruction sets, computing code, computer code, code segments, computer code segments, words, values, symbols, or any combination thereof.

According to some examples, a computer-readable medium may include a non-transitory storage medium to store or maintain instructions that when executed by a machine, computing device or system, cause the machine, computing device or system to perform methods and/or operations in accordance with the described examples. The instructions may include any suitable type of code, such as source code, compiled code, interpreted code, executable code, static code, dynamic code, and the like. The instructions may be implemented according to a predefined computer language, manner or syntax, for instructing a machine, computing device or system to perform a certain function. The instructions may be implemented using any suitable high-level, low-level, object-oriented, visual, compiled and/or interpreted programming language.

Some examples may be described using the expression "in one example" or "an example" along with their derivatives. These terms mean that a particular feature, structure, or characteristic described in connection with the example is included in at least one example. The appearances of the phrase "in one example" in various places in the specification are not necessarily all referring to the same example.

Some examples may be described using the expression "coupled" and "connected" along with their derivatives. These terms are not necessarily intended as synonyms for each other. For example, descriptions using the terms "connected" and/or "coupled" may indicate that two or more elements are in direct physical or electrical contact with each other. The term "coupled," however, may also mean that two or more elements are not in direct contact with each other, but yet still co-operate or interact with each other.

It is emphasized that the Abstract of the Disclosure is provided to comply with 37 C.F.R. Section 1.72(b), requiring an abstract that will allow the reader to quickly ascertain the nature of the technical disclosure. It is submitted with the understanding that it will not be used to interpret or limit the scope or meaning of the claims. In addition, in the foregoing Detailed Description, it can be seen that various features are grouped together in a single example for the purpose of streamlining the disclosure. This method of disclosure is not to be interpreted as reflecting an intention that the claimed examples require more features than are expressly recited in each claim. Rather, as the following claims reflect, inventive subject matter lies in less than all features of a single disclosed example. Thus the following claims are hereby incorporated into the Detailed Description, with each claim standing on its own as a separate example. In the appended claims, the terms "including" and "in which" are used as the plain-English equivalents of the respective terms "comprising" and "wherein," respectively. Moreover, the terms "first," "second," "third," and so forth, are used merely as labels, and are not intended to impose numerical requirements on their objects.

In some examples, first methods may include receiving sensor information from one or more sensors located with a network computing device housed in a chassis. One or more fans housed in the chassis may be adjusted based on the received sensor information. The one or more fans may be adjusted to provide airflow in a first direction towards an area above the chassis or in a second direction away from the area above the chassis.

According to some examples for the first methods, the sensor information may include a comparison of a first temperature for the area above the chassis to a second temperature for the area below the chassis. The one or more fans may be adjusted to provide airflow in the second

direction based on the comparison indicating the first temperature is lower than the second temperature.

In some examples, the chassis may be mounted in a ceiling space or a floor space for a room.

In some examples for the first methods, power may be provided to an LED array based on the received sensor information. The LED array may be attached with a portion of the chassis such that the powered LED array is capable of providing overhead lighting to the room when the chassis is mounted to the ceiling space above the room.

According to some examples for the first methods, the sensor information may include motion sensor information or light sensor information. Also, providing power to the LED array may include providing power based, at least in part, on the motion sensor information indicating movement in the room or based on the light sensor information indicating an ambient light level in the room has fallen below a threshold light level.

In some examples for the first methods, power may be provided to the LED array based on the received sensor information or based on a given time of day associated with a 24-hour time cycle.

In some examples for the first methods, the network computing device may be coupled with an aggregator that communicatively couples the network computing device and an array of other network computing devices with a manager computing device capable of controlling or managing one or more operations of the network computing device and the array of other network computing devices through the aggregator. The array of other network computing device may be housed in separate chassises mounted in the ceiling space or the floor space for the room.

According to some examples for the first methods, the one or more fans may be adjusted responsive to receiving an action command from the manager computing device. The action command to cause the one or more fans to provide airflow in the second direction.

According to some examples, a first apparatus or device may include a network computing device, one or more fans, a chassis to house the network computing device and the one or more fans. The first apparatus may also include one or more thermal sensors capable of sensing a first temperature for an area above the chassis and a second temperature for an area below the chassis. The one or more fans may be arranged to provide the airflow through the chassis in a direction based on a comparison of the first temperature to the second temperature.

In some examples for the first apparatus, the comparison of the first temperature to the second temperature may indicate the first temperature is lower than the second temperature. For these examples, the direction may include the one or more fans providing the airflow through the chassis away from the area above the chassis.

According to some examples for the first apparatus, the comparison of the first temperature to the second temperature may indicate the first temperature is higher than the second temperature. For these examples, the direction may include the one or more fans to provide the airflow through the chassis towards the area above the chassis.

In some examples for the first apparatus, the one or more thermal sensors may include a sensor located with the network computing device and housed in the chassis, The sensor may sense a third temperature for air located within the chassis. The one or more fans may be capable of being activated to provide airflow based on a comparison of the third temperature to a threshold temperature value.

According to some examples for the first apparatus, the chassis may include a mounting mechanism capable of mounting the chassis in a ceiling space or a floor space of a room.

According to some examples for the first apparatus, an LED array may be capable of attaching to a portion of the chassis such that responsive to receiving power, the LED array may be capable of providing overhead lighting to the room when the chassis is mounted to the ceiling space above the room.

In some examples for the first apparatus, the network computing device may be capable of coupling to an aggregator that communicatively couples the network computing device and an array of other network computing devices with a manager computing device capable of controlling or managing one or more operations of the network computing device and the array of other network computing devices.

According to some examples, second methods may include coupling an array of network computing devices separately housed in chassises mounted in a ceiling space or a floor space for one or more rooms. Coupling may include using an aggregator to route separate communication links between the aggregator and each network computing device of the array. For these examples, the array of network computing devices may be managed through the aggregator using a manager computing device capable of including a user-interface to enable a user to manage or control one or more operations of the aggregator or the array of network computing devices.

In some examples for the second methods, coupling may include using the aggregator to route separate power links to each network computing device of the array and powering the array of network devices through the separate power connections.

According to some examples for the second methods, managing or controlling through the aggregator may include the aggregator modifying a power state of a network computing device of the array of network computing device responsive to an action command received from the manager computing device.

In some examples for the second methods, managing or controlling through the aggregator may include the aggregator providing operating information for the aggregator and the array of network computing devices responsive to a query command received from the manager computing device.

According to some examples for the second methods, the operating information may include one or more of an aggregator identification, a physical location of the aggregator, separate media access control addresses for each network computing device of the array of network computing devices, power states for each network computing device of the array of network computing devices or thermal characteristics for each network computing device of the array of network computing devices.

In some examples for the second methods, managing or controlling through the aggregator may include the aggregator forwarding an action command initiated by the user or the manager computing device. The action command may modify one or more operating parameters for at least one network computing device of the array of network computing devices.

According to some examples for the second methods, the one or more operating parameters may include a direction of

airflow provided by one or more fans included in the chassises for at least some of the network computing devices of the array of network computing devices, the direction of airflow to be adjusted towards the one or more rooms or away from the one or more rooms based on the action command.

In some examples for the second methods, the one or more operating parameters may include powering a light emitting diode (LED) array attached with a portion of the chassises for at least some of the network computing devices such that the powered LED array is capable of providing overhead lighting to the one or more rooms.

According to some examples, a second apparatus or device may include an aggregator capable of being configured to couple an array of network computing devices separately housed in chassises mounted in a ceiling space or a floor space for one or more rooms to a manager computing device. The aggregator may also be capable of being configured to communicate with the manager computing device to enable a user to manage or control one or more operations of the array of network computing devices.

According to some examples for the second apparatus, the aggregator may couple the array of network computing devices via separate communication links between the aggregator and each network computing device of the array.

In some examples for the second apparatus, the aggregator may be capable of being configured to route separate power links to each network computing device of the array. The aggregator may also be capable of being configured to provide power to the array of network devices through the separate power links.

According to some examples for the second apparatus, the aggregator may be capable of being configured to route separate communication and power links to each network computing device of the array, the separate communication and power links each routed via a single cable.

In some examples for the second apparatus, the single cable may be arranged to operate in compliance with an industry standard to include PoE+.

In some examples for the second apparatus, the aggregator may be capable of providing operating information for the array of network computing devices responsive to a query command received from the manager computing device.

According to some examples for the second apparatus, the operating information may include one or more of an aggregator identification, a physical location of the aggregator, separate media access control addresses for each network computing device of the array of network computing devices, power states for each network computing device of the array of network computing devices, thermal characteristics for each network computing device of the array of network computing devices.

In some examples for the second apparatus, the aggregator may be capable of being configured to implement or forward an action command initiated by the user or the manager computing device. The action command may modify one or more operating parameters for at least one network computing device of the array of network computing devices.

Although the subject matter has been described in language specific to structural features and/or methodological acts, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as example forms of implementing the claims.

What is claimed is:

1. A method comprising:

receiving, at an aggregator, sensor information from one or more sensors located with a network computing device housed in a chassis mounted in a ceiling space above a ceiling for a room or in a floor space below a floor for the room, the one or more sensors including one or more thermal sensors capable of sensing a first temperature for an area above the chassis and a second temperature for an area below the chassis;

adjusting one or more fans housed in the chassis based on the received sensor information including a comparison of a first temperature for the area above the chassis to a second temperature for an area below the chassis, the one or more fans adjusted to provide airflow in one of two directions including a first direction towards an area above the chassis and a second direction away from the area above the chassis, the one or two directions to enable the network computing device to provide heated air to the room; and

gathering location information, the location information to indicate a physical location of the aggregator.

2. The method of claim **1**, comprising the one or more fans adjusted to provide airflow in the second direction based on the comparison indicating the first temperature is lower than the second temperature.

3. The method of claim **1**, comprising providing power to a light emitting diode (LED) array based on the received sensor information, the LED array attached with a portion of the chassis such that the powered LED array is capable of providing overhead lighting to the room when the chassis is mounted to the ceiling space.

4. The method of claim **3**, the sensor information including motion sensor information or light sensor information, providing power to the LED array comprises providing power based, at least in part, on the motion sensor information indicating movement in the room or based on the light sensor information indicating an ambient light level in the room has fallen below a threshold light level.

5. The method of claim **3**, comprising providing power to the LED array based on the received sensor information or based on a given time of day associated with a 24-hour time cycle.

6. The method of claim **1**, the aggregator to communicatively couple the network computing device and an array of other network computing devices with a manager computing device capable of controlling or managing one or more operations of the network computing device and the array of other network computing devices through the aggregator, the array of other network computing device housed in separate chassises mounted in the ceiling space or the floor space of the room.

7. The method of claim **6**, comprising adjusting the one or more fans in the one of two directions responsive to receiving an action command from the manager computing device, the action command to cause the one or more fans to provide airflow in the second direction.

8. An apparatus comprising:

a network computing device;

one or more fans;

a chassis to house the network computing device and the one or more fans, the chassis including a mounting mechanism capable of mounting the chassis in a ceiling space above a ceiling for a room or in a floor space below a floor for the room;

one or more thermal sensors capable of sensing a first temperature for an area above the chassis and a second

temperature for an area below the chassis, the one or more fans arranged to provide the airflow through the chassis in one of two directions based on a comparison of the first temperature to the second temperature, the one or two directions to enable the network computing device to provide heated air to the room; and

an aggregator to communicatively couple the network computing device to a network and gather location information, the location information to indicate a physical location of the aggregator.

9. The apparatus of claim **8**, based on the comparison indicating the first temperature is lower than the second temperature, the one of two directions comprises the one or more fans to provide the airflow through the chassis away from the area above the chassis.

10. The apparatus of claim **9**, based on the comparison indicating the first temperature is higher than the second temperature, the one of two directions comprises the one or more fans to provide the airflow through the chassis towards the area above the chassis.

11. The apparatus of claim **8**, comprising the one or more thermal sensors including a sensor located with the network computing device and housed in the chassis, the sensor to sense a third temperature for air located within the chassis.

12. The apparatus of claim **11**, comprising the one or more fans capable of being activated to provide airflow in the one of two directions based on a comparison of the third temperature to a threshold temperature value.

13. The apparatus of claim **8**, comprising:

a light emitting diode (LED) array capable of attaching to a portion of the chassis such that responsive to receiving power, the LED array is capable of providing overhead lighting to the room when the chassis is mounted to the ceiling space above the room.

14. The apparatus of claim **8**, the aggregator to communicatively couple the network computing device and an array of other network computing devices with a manager computing device capable of controlling or managing one or more operations of the network computing device and the array of other network computing devices.

15. A method comprising:

coupling an array of network computing devices separately housed in chassises mounted in a ceiling space above a ceiling for one or more rooms or a floor space below a floor for the one or more rooms, coupling to include using an aggregator to route separate communication links between the aggregator and each network computing device of the array;

gathering location information, the location information to indicate a physical location of the aggregator; and

managing the array of network computing devices through the aggregator using a manager computing device capable of including a user-interface to enable a user to manage or control one or more operations of the aggregator or the array of network computing devices, managing the array of network computing devices including the aggregator forwarding an action command initiated by the user or the manager computing device, the action command to modify one or more operating parameters for at least one network computing device of the array of network computing devices, the one or more operating parameters including one of two directions of airflow provided by one or more fans included in the chassises for at least some of the network computing devices of the array of network computing devices, the one of two directions of airflow including a first direction towards the one or more rooms and a second direction away from the one or more rooms, the one or two directions to enable the array of network computing devices to provide heated air to the one or more rooms.

16. The method of claim **15**, comprising coupling to include using the aggregator to route separate power links to each network computing device of the array and powering the array of network devices through the separate power connections.

17. The method of claim **16**, managing through the aggregator comprises the aggregator modifying a power state of a network computing device of the array of network computing device responsive to an action command received from the manager computing device.

18. The method of claim **15**, managing through the aggregator comprises the aggregator providing operating information for the aggregator and the array of network computing devices responsive to a query command received from the manager computing device.

19. The method of claim **18**, the operating information including one or more of an aggregator identification, the physical location of the aggregator, separate media access control addresses for each network computing device of the array of network computing devices, power states for each network computing device of the array of network computing devices or thermal characteristics for each network computing device of the array of network computing devices.

20. The method of claim **15**, comprising the one or more operating parameters including powering a light emitting diode (LED) array attached with a portion of the chassises for at least some of the network computing devices such that the powered LED array is capable of providing lighting to the one or more rooms.

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